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THE ARGYNNIS POPULATIONS OF THE SAND CREEK AREA, KLAMATH CO., OREGON

PART I: THE EFFECT OF THE FORMATION OF MT. MAZAMA ON THE AREA AND ITS POSSSIBLE INFLUENCE ON THE BUTTERFLY FAUNAS OF THE SAND CREEK BASIN.

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INTRODUCTION

THE POPULATIONS OF ARGYNNIS (SPEYERIA) found in eastern Oregon share with similar populations in many parts of western United States, a tendency to great variation and to a breakdown of the distinctive appearance of many of the named geographical phenotypes (subspecies). The region drained by Sand Creek, lying east of Crater Lake in Klamath County, Oregon, is occupied by populations of *Argynnis* exhibiting this variation to a marked degree.

The Sand Creek area was chosen for study not only because of the variability of its *Argynnis* fauna, but in particular because it is a region the recent geological history which is fairly well understood, and inferences may be drawn of the possible effect of this geological history on the several species of *Argynnis* now inhabiting this region.

Part I of this paper will deal with the recent geological history of Mt. Mazama and the nearby lands to the east of Crater Lake, and the possible influence of these events on the faunas now living in this region. Part II will attempt an analysis of the variation of these *Argynnis* populations, and is postponed until much more field work can be done so that a proper appreciation of the extent of variation is possible.

BACKGROUND

The stability of certain isolated populations has been interpreted as due to long occupation of the present habitat. This time element has been construed as allowing stabilization, without undue influence from surrounding populations. Such conditions infer stability in the habitat, without the disturbing influence of earth changes in the area. Such stable habitats have been referred to as refugia.

Opposed to such a condition of stability, many portions of the earth's surface have been subjected to changes more frequently, and some of these changes have occurred in very recent times. Eastern Oregon is a region of many lava flows, and scoria and cinder falls, and the effects of these actions are still clearly visible in numerous places. It is suggested that such phenomena must have had a major effect upon any butterfly populations existing in the regions where such events took place.

THE SAND CREEK BASIN AND ITS RECENT GEOLOGICAL HISTORY

Sand Creek rises at Anderson Spring, elevation 7088 ft, slightly northeast of Kerr Notch in Crater Lake National Park, and runs easterly, leaving the park in the near vicinity of the now unused East Entrance. It continues out of the park, the elevation gradually decreasing. The area chosen for study is that from Lost Creek Campground, Crater Lake National Park, 5972 ft., located between Sand Creek and its branch, Wheeler Creek, and the point at which Highway 232 ("Old 97") crosses Sand Creek. This area is readily accessible. Work in the Crater Lake National Park was possible under a permit from the National Park Service.

The *Argynnis* samples indicate that the following species are represented: *Argynnis* (*Speyeria*) *coronis* Behr, *zerene* Bdv., *callippe* Bdv., *egleis* Behr, *atlantis* Edw., and *hydaspe* Bdv. Possibly others may be present in lesser numbers but have not yet been collected. It is interesting to note that *Argynnis cybele* (*leto*) appears to be absent from the region, and also from all of Crater Lake National Park, though common west of the Cascade divide, and also in the Blue Mountains of eastern Oregon. The scarcity in the Sand Creek Basin of suitable wet habitats, or the recency of earth surface changes, may be clues to its absence.

Fair samples of these various species, collected by the author and also by others, have been examined, and it is evident that the degree of variation is surprising. As stated above, analysis of these and future samples is postponed until later, but enough information is now available to make it apparent that the populations of each species involved are far from stable. Many individuals resemble no named geographic segregate. Some species are represented by individuals resembling two or more named segregates and it is evident that no equilibrium in phenotype has been reached by any of the several species inhabiting the area.

Crater Lake is not a true crater, but a caldera, brought into its present form by the collapse inwardly of the summit of Mt. Mazama. In its most developed state, Mt. Mazama was more than 12,000 ft. in height. During the Pleistocene, it developed its greatest elevation, produced a great lava flow, and was subsequently glaciated extensively. The effects of this glaciation are visible around the present rim of the lake. Later, the present Crater Lake was formed by the collapse inwardly of the upper mile or so of Mt. Mazama, with attendant glowing avalanches of scoria and pumice and great clouds of pumice dust. The area east of the lake was covered with pumice and scoria from the glowing avalanches. The land still further east was covered by pumice falls that reached a depth of ten feet or more close to the mountain, and gradually thinned out easterly, extending in at least a very thin layer, approximately fifty miles to the east.

It is believed that the glaciers, or some of them, must still have been present when the collapse took place, since the residue of scoria and pumice is light in certain areas around the rim. This would be the situation if the scoria and pumice fell onto glaciers and was carried away in part. If it had fallen in every case on bare ground, it would be left there. This may explain why the present pumice soils are more extensive in the non-glacial areas. It is believed also that the collapse took place in winter, because there is relatively little evidence of severe forest fires in the wake of the collapse. If the collapse had taken place in the summer, it has been reasoned that the forest fires surely would have been more extensive.

There seems to be agreement that most or all of the vegetation was destroyed within the effective range of the scoria and pumice avalanches and of the heavier pumice fall. If this is correct, the present vegetation of the entire region must have regrown since the collapse took place. The rate of recovery of the vegetation seems to have been inversely proportional to the depth of the pumice and scoria that covered a given area. The prevailing winds are believed to have been much the same then as now, basically western, since the pumice was carried much further east than west.

The Sand Creek Basin is situated so that it received very heavy pumice fall, and very probably, extensive to complete vegetational destruction.

Carbon dating of wood that is imbedded in the pumice, and which is therefore assumed to have been charred by the glowing avalanches of pumice and scoria, sets the time of the collapse at 6640 ± 250 years. In round numbers, popular accounts state this as 6550 years. From this it is inferred that the Sand Creek Basin became a sterile habitat at that time.

It is of interest to observe that such streams as Upper Sand Creek and Wheeler Creek, below Kerr Notch, have deep V-shaped canyons, geologically very young and without sign of glaciation such as that found on the rocks of the Rim above. From this it seems clear that Sand Creek acquired its present bed recently. Indeed, its present course may very well be consequent to the recent geological events of the area. The depth of the pumice is also clearly visible.

Knowledge of the date when the vegetation was destroyed allows some speculation concerning present vegetational cover of the region. Recovery of the vegetation must have lagged for many years. The types of vegetation found in the total Crater Lake region permit some understanding of the relative times of recovery. In Crater Lake National Park, the forest along the southern boundary is a mature Sierran Coniferous Forest of Ponderosa Pine, Sugar Pine, White Fir, Douglas Fir and Incense Cedar, with an understory of Snow Brush (*Ceanothus velutinus*) and Greenleaf Manzanita (*Arctostaphylos patula*). The forest of the flanks of the mountain on the southern and western slopes is a mature Mountain Hemlock-Shasta Fir Forest, with increasing amounts of Subalpine Fir at higher elevations. Such forests have relatively less understory. The highest elevations support Whitebark Pine.

Northerly and easterly, in the areas of greater pumice fall, (as for instance the Pumice desert) the forest has not even yet succeeded in taking over the denuded and pumice-covered land. In the intermediate areas where the forest is slowly invading and colonizing the .pumice soils, the successful pioneer is Lodgepole Pine, which on such soils forms a singularly uniform and barren type of forest with very few underplants.

The soils of the study area are formed of pumice and scoria and from the foregoing evidence, are derived from the pumice fall from the collapse of Mt. Mazama. The forest here is essentially Lodgepole Pine Forest, of the type found also on the pumice at higher elevations in the park. The soils and the forest are evidently contemporary in the Sand Creek Basin, with those occurring on pumice within the park itself. We should regard the forest cover of the Sand Creek Basin as equally recent.

Dating of the pumice fall and the destruction of the vegetation give a reference point. Vegetational recovery must involve a very considerable period of time. This reasonably will be longer in areas where the pumice fall is deeper. While no exact figure can at present be suggested for the age of the current forest cover of the Sand Creek Basin, it must be very much less than 6640 ± 250 years. Very likely portions of it may be a fraction of this age.

From this it seems evident that the *Argynnis* populations of the Sand Creek Basin (and similar areas) are occupying habitats that are the opposite of refugia. The time in occupation of contemporary populations on such disturbed areas is brief.

DISCUSSION

Assuming an area from which vegetation has been destroyed, with attendant soil changes, and with sufficient time elapsed to allow new vegetation to occupy the area, we may well expect certain things to take place, among which the folowing may be suggested.

1. The vegetation that recolonizes the land will in all possibility be different than that which previously grew in the area. Most likely many previous floral components would now find the area inhospitable.

2. Recolonization of the habitat by organisms would theoretically

be possible from any portion of the surrounding regions. It may be expressed by saying that recolonization could be expected to be *multi-directional* unless some factor prevented recolonization from one or more directions.

3. Such recently recolonized areas would contain mixed populations the components of which may have moved in from any of the surrounding regions.

4. If such heterogeneous populations are studied before adequate time for stabilization has passed, it is predicted that great variation in individual phenotype will be present.

Expressing this in terms more directly related to the *Argynnis* populations of the Sand Creek Basin, it is tentatively concluded that the variability of these several populations is in part a result of the recency with which they have established themselves in this area following a major change in habitat, and in part a result of recolonization by an unknown number of varying populations from the surrounding regions.

Less tangible are two other possibilities. One is that the time during which the Sand Creek Basin was unsuitable for habitation by *Argynnis* was of sufficient duration to allow the surrounding populations which it separated, to diverge to some extent. The other is that the recent forest cover of the pumice soils may differ sufficiently in its selective factors so that the eventual stable population may when developed differ from those around it.

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